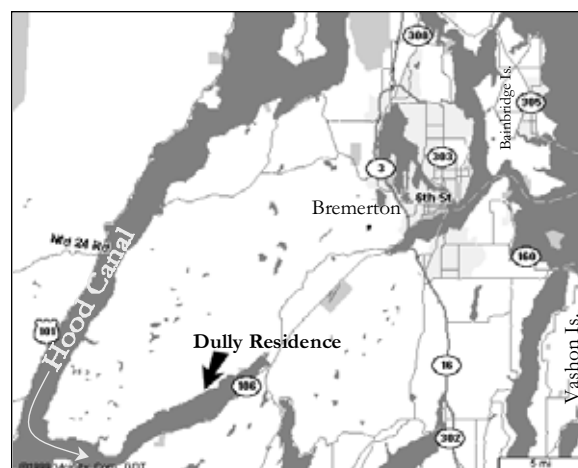


Dully Residence

Address: **NE Landon Road, Belfair, WA**
 Region: **Southern end of the Hood Canal**
 Designer: **Michael Dully**
 Contractor: **Butch's Bulldozing**
 Owner: **M. Dully**
 Shoreline Type: **Beach**
 Project Type: **Large Woody Debris
Buried Rock Revetment**
 Wave Energy: **Low**
 Tides: **MHHW: +11.4
Extreme High: +15.0
Extreme Low: -4.5**
 Cost: **\$15,500**
 Date Completed: **September 1998**



Location: Dully Residence in Puget Sound

Site History / Description

The Dully residence is located at the southern end of the Hood Canal approximately 20 miles south southeast of Bremerton, WA. It is on the northern shore of the canal and the prevailing winds and waves are from the southwest.

The property's 137' of marine shoreline are situated on a no-bank shoreline with two vertical concrete bulkheads on adjacent preproperties. These structures were constructed between 1989 and 1990 while the homeowner was living on the East

Coast. By 1994, when the Dullys returned to Washington, between 10 and 15 feet of beach had eroded. The loss was most dramatic on the west end of the sight where reflected wave energy from the neighboring bulkhead is severe.

The site had once been protected by a log bulkhead that had long since failed and rotted away. The landowner was concerned about losing additional beach and originally wanted to install a bulkhead, but was convinced by WDFW personnel that an alternative approach could serve the same function and



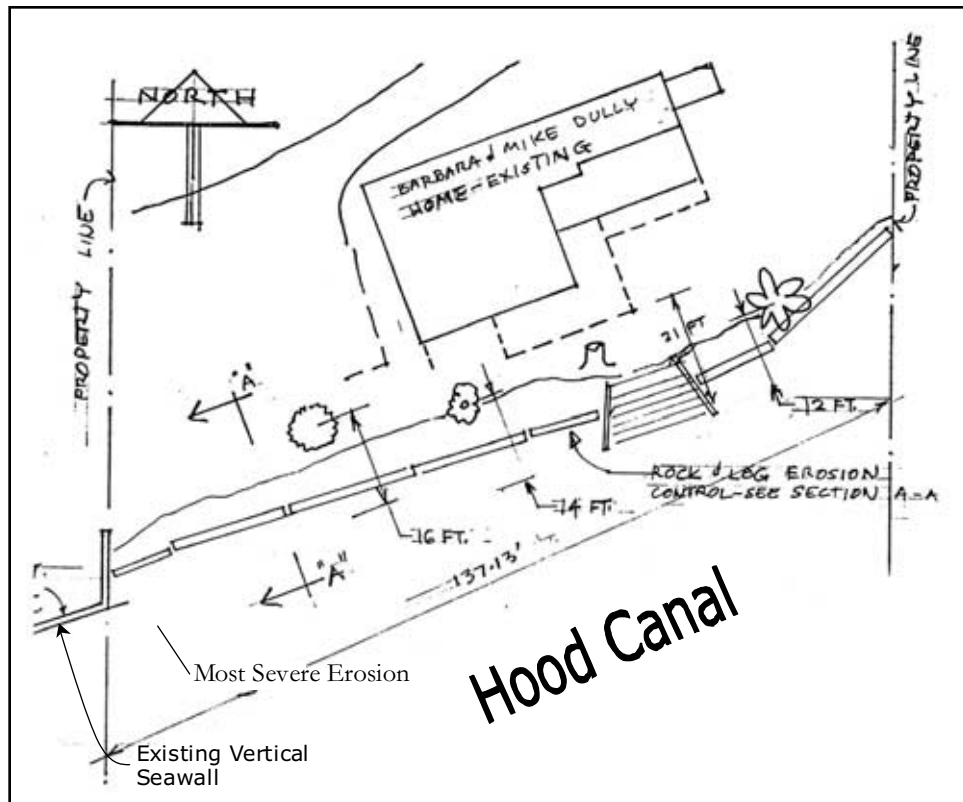
Location: Dully Residence on Hood Canal

reduce impacts to the beach. The landowner was very enthusiastic about preserving the beach and developed the design himself.

Project Description

The project was composed of three basic steps. 1) A wide trench was cut into the beach for placement of a buried rock revetment; 2) logs were anchored; and 3) the backshore was replanted with native beach grasses.

The rock revetment is about 10' wide and was cut into the beach. It begins where the beach surface is at +11.8' and ends at +14'. The bottom of the revetment is approximately level at the +10' elevation. At +11.8' the revetment is cut in two feet into the beach and by +14' the revetment is 4' beneath the sand. After placement the rock was covered with six inches of gravel and the beach was brought back up to its original grade. This structure runs for almost the entire width of the property.



Dully Residence: Site Plan

Logs 20' long and 18" in diameter were then run down the middle of the revetment. They were spaced several feet apart and were anchored into the beach with Manta Ray type earth anchors. These logs were partially keyed into the beach as well.

Finally the space between the logs and the top of the bank was replanted with native beach grass.

Monitoring

No official monitoring is being performed at the site. There still seems to be a small erosion problem at the west end where problems were the most extreme prior to the project. However, during the first winter (1998-'99) a significant amount of gravel was deposited on the beach and was retained above the anchored logs. One year after installation, when the photos for this report were taken, the logs were buried across most of the site rising out of the sand at either end of the site.

Success

The project has been successful to date.

Alternatives Considered

Initially, the landowner was interested in installing a bulkhead similar to the ones on the adjacent properties, but the WDFW would have required that the bulkhead be installed further landward (i.e. at or landward of Ordinary High Water). This requirement, in conjunction with the loss of natural beach conditions, discouraged the Dully's from pursuing this alternative. A mostly buried rock wall was initially proposed. Through discussions with WDFW, the plans underwent several transformations in the volume of construction materials and position of the logs (i.e. from almost perpendicular to the bank to parallel to the bank). In the end, it was determined that a single row of logs, installed parallel to the bank, would be sufficient to achieve the desired protection and beach functions.

Contacts

Department of Fish and Wildlife:	J. Brennan (now with King County DNR)
	N. Rickard
Mason Co. Dept. of Community Development:	A. Borden
King Co. DNR:	J. Brennan
Designer:	M. Dully

Project Design Profile

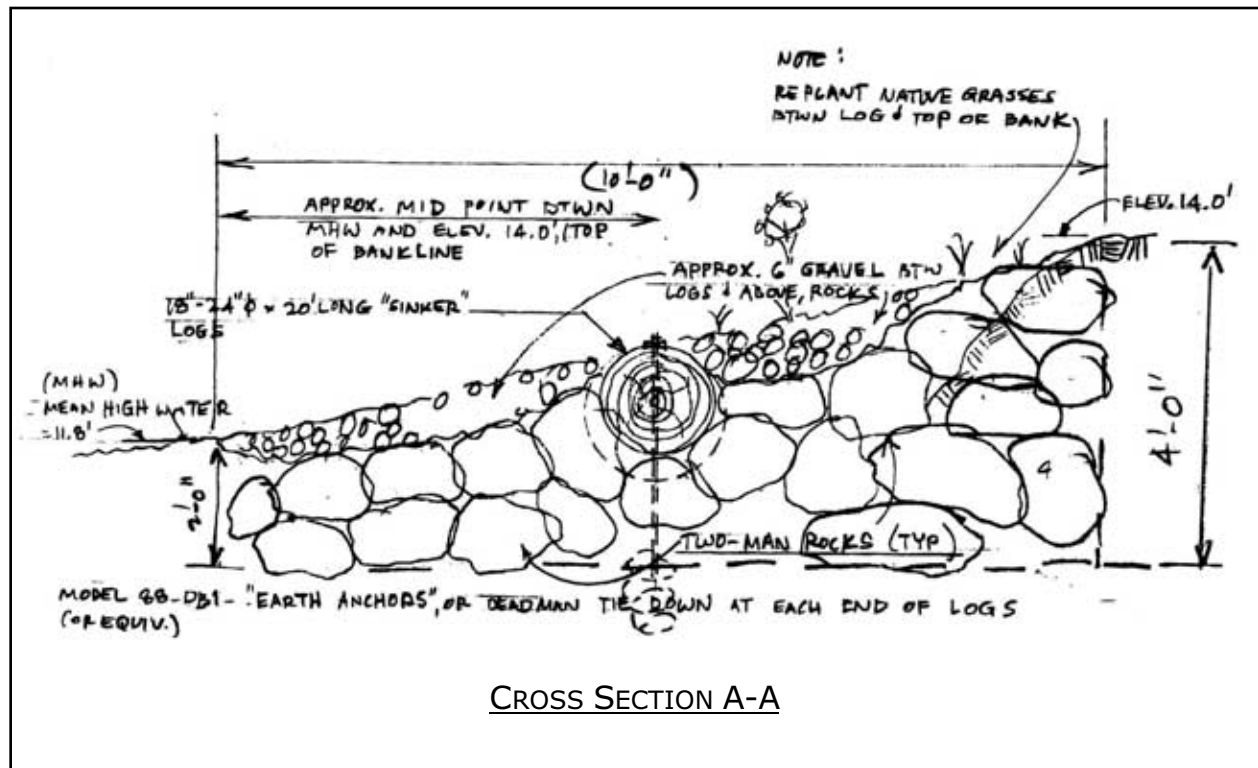




Figure 1. West end of site prior to construction. Note significant scarping and the amount of the neighboring bulkhead's wing wall that is exposed.



Figure 2. View of west end of site during construction. Large amount of rock provides an emergency bottom in the event that the beach drops (*Photo: Jim Brennan*).



Figure 3. View of east end of site following completion of project. The logs rise out of beach and curve back to meet neighbor's bulkhead.



Figure 4. View of site from the west. Logs have been covered by accretion along much of beach. The logs reemerge at the far (west) end where a pile of rock reduces the impacts of the neighboring bulkhead.

Floral Point, SUBASE Bangor

Address: **Bangor, WA**

Region: **West Shore of the Hood Canal**

Designer: **Foster Wheeler Environmental Corp.**

Contractor: **Foster Wheeler Environmental Corp.**

Owners: **US NAVY**

Shoreline Type: **Former Sand Spit & Lagoon**

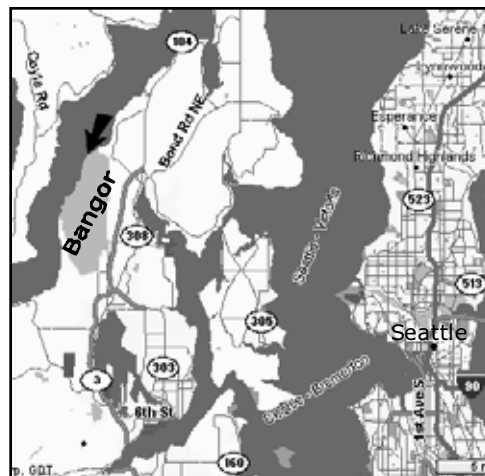
Project Type: **Beach Nourishment**

Wave Energy: **Medium**

Tides: **MHHW: +11.13**
Extreme High: +14.0
Extreme Low: -4.5

Cost: **N/A**

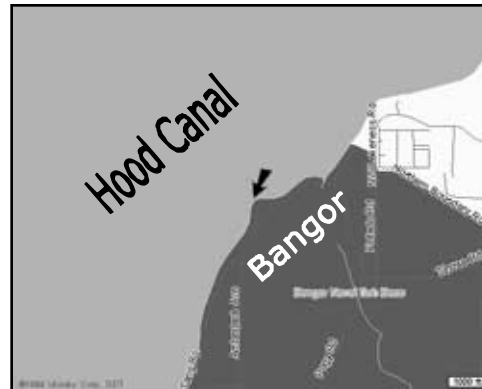
Date Completed: **11/97**



Location: SUBASE Bangor in Puget Sound

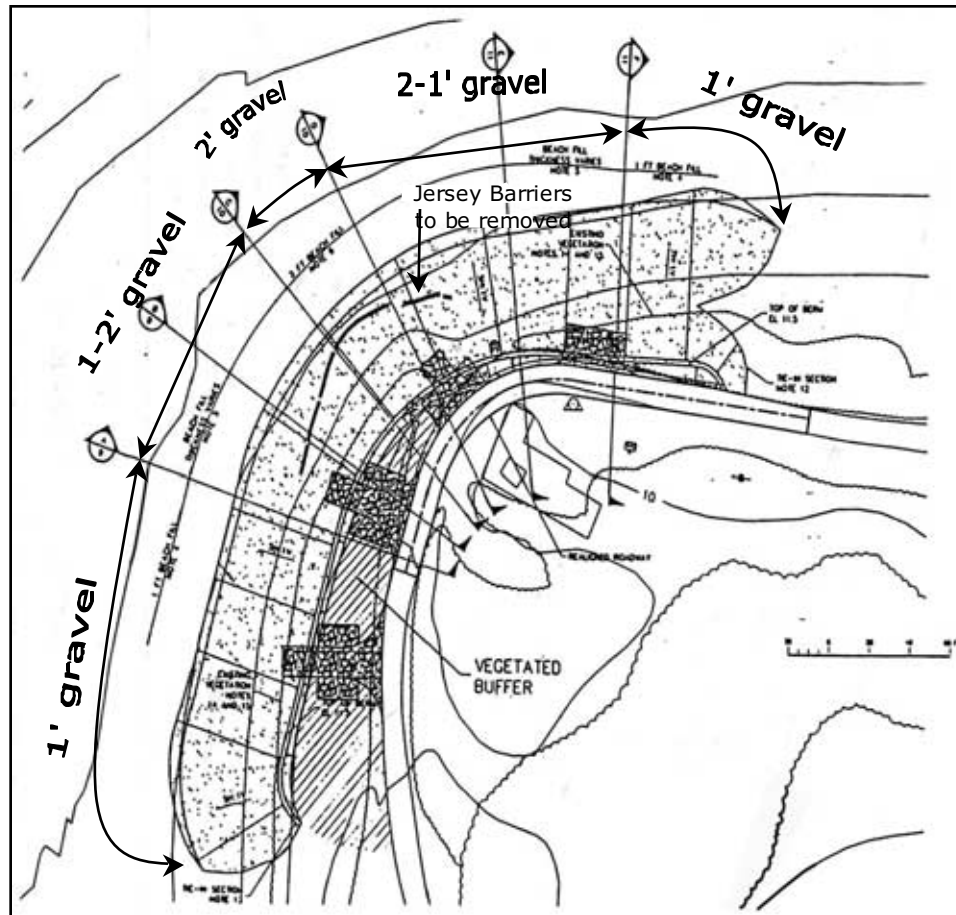
Site History / Description

Floral Point is a 4.7 acre site on the eastern shore of Hood Canal within the Bangor Submarine Base. There are 500 feet of marine shoreline and 2 wetland areas on site. Historically it was a sand spit with a lagoon behind it. The lagoon was filled between 1950 and 1968. During this period the site was used as a pyrotechnic testing site. From 1967 through 1972 the site was used as a disposal area for solid waste from the Naval Undersea Warfare Engineering Station. Since 1972 the site has been used for dumping construction refuse.



Location: Floral Point at Bangor

In 1990 Floral Point was identified as a CERCLA site and put on the National Priority List. The authority of the Superfund legislation was the driving force for the site cleanup. It was determined that the level of contamination present required only a cap to prevent human contact with the toxic material. Concerns about erosion releasing contaminants from the fill or damaging the cap also needed to be addressed. The site is subject to significant wind-generated wave action.



Site Plan: Floral Point, Bangor Submarine Base

Project Description

The Floral Point project started with beach stabilization (i.e. nourishment) and was completed with upland construction and restoration. Following the removal of jersey barriers, which had been placed as a temporary erosion protection measure, 3310 tons of gravel/sand blend were placed on the beach. In some areas, the fill was between one and two feet thick. This was graded to a slope that ranged between 7H:1V and 5H:1V and a thin layer of coarse sand (65 tons) was layered on top of the base material. The purpose of the sand and gravel beach nourishment (Foster Wheeler, 1999) was to dissipate wave energy and to act as a soft barrier to upland erosion. The nourishment was planned so as to provide suitable spawning habitat for surf smelt and sandlance.

The purpose of the upland fill was to cap the contaminated soils to prevent any possible future contact with the hazardous material and create a marsh habitat. A one-foot thick cap was built over the former landfill. It consisted of a 2832 yd³ of topsoil mix that was compacted in 4-inch layers. When the cap was in place, 200 yards of mulch were spread on the surface and 5100 plants were used to vegetate the berm and build a wetland area.

Floral Point, SUBASE Bangor



Floral Point: Planting Diagram

Monitoring

During work on the berm, 10 survey monuments were installed. These are used to do profile monitoring at the site. The monitoring schedule is as follows:

	March	April	May	June	July	August	September	October
1998		✓	✓		✓			✓
1999	✓	✓	✓	✓				✓
2000	✓							✓
2001	✓							✓
2002	✓							✓

In addition to these scheduled examinations there will be monitoring after major storm events as well. After the fifth year the monitoring will switch to visual inspection if the beach has been stable during the first five.

Success

Alternative Bank Protection Methods on Puget Sound

Initial reports suggest some sediment has been lost from the south end of the beach, as littoral drift has moved toward the point or the beach on the north side. Some readjustment of the beach profile was expected. Renourishment with gravel can occur if monitoring indicates significant erosion in coming years.

There is evidence that surf smelt and sand lance are both using the new beach for spawning.

Alternatives Considered

N/A

Contact

Department of Fish and Wildlife:	J. Boettner (now with WA State DNR)
	J. Brennan (now with King County DNR)
Department of Ecology:	M. Abbett
Agua Tierra Environmental Consulting, Inc.	C. Fromuth
SUBASE Bangor	P. Kelly

References

Foster Wheeler Environmental Corp. 1999. Remedial Action Report – Floral Point, Site B, Operable Unit 7, Naval Submarine Base Bangor, WA. Contract No. N44255-95-D-6030.



Figure 1. Southwest facing portion of site. Southern limit of project area is marked with arrow.



Figure 2. View south from western point. Photo provides good profile perspective of the work. Note that vegetation has established on the bench and a vegetated berm has begun to form on the upper beach.



Figure 3. Wetland reconstruction on cap. This area was relatively dry when photos were taken (July), but the area in the center is wet and marshy earlier in the year.



Figure 4. Slope and backshore with road. The position of the road affected the overall design of the project and the grade chosen for the upper beach.

Indian Island

Address: **Naval Ordinance Center Pacific
Division, Detachment Port Hadlock,
Port Hadlock**

Region: **North East Jefferson County, southeast
side of Port Townsend Bay**

Designer: **Agua Tierra Environmental
Consulting, subcontractor to Ebasco
Services Inc.**

Contractor: **Ebasco Services**

Owner: **NAVY**

Shoreline Type: **Former Tidal Lagoon**

Project Type: **Rock Revetment, Large
Woody Debris,
Bioengineering**

Wave Energy: **High/Low/Very Low**

Tides: **MHHW: 8.45
Extreme High: +11.77**

Cost: **N/A**

Date Completed: **June 1997**

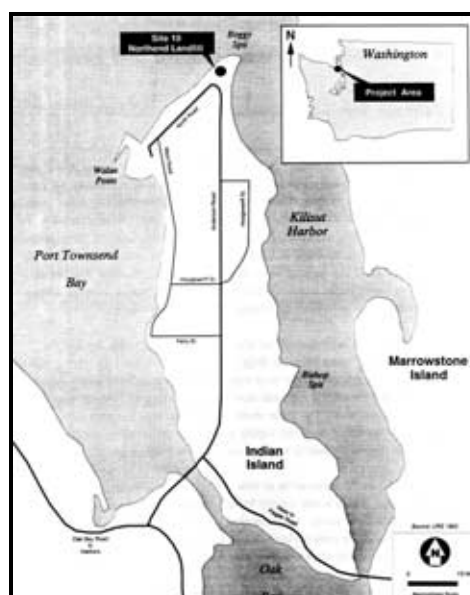


Site History / Description

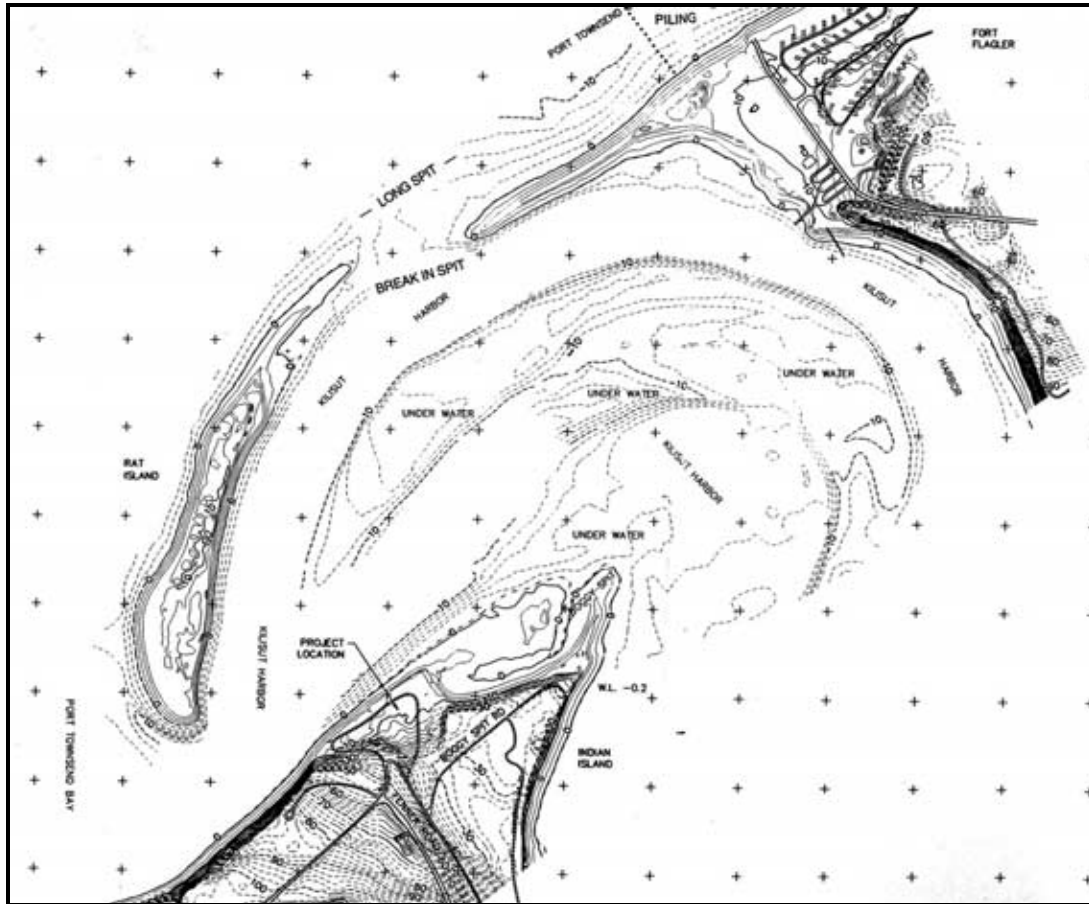
The Site 10 Northend Landfill site is located at the north end of Indian Island (approximately 3 miles south southeast of Port Townsend across Port Townsend Bay).

Historically the site was a tidal lagoon but since has been used as a landfill by the United States Navy. From the 1940's through the 1970's solid wastes, petroleum and paint wastes and ash and slag from an adjacent incinerator were disposed of at Site 10. In 1994 the location was identified as a Comprehensive Environmental Response Compensation & Liability Act (CERCLA) site. Remedial actions included capping 3.7 acres of contaminated

sediments and constructing shore protection along 900' of shoreline to prevent erosion from exposing toxic substances and debris.



Site 10 is bound by Port Townsend Bay to the Northwest and by a tidal lagoon to the Northeast. The site can be divided into three distinct zones of wave energy. These zones are a result of the complexity of the surrounding geomorphology. While Rat Island and Sandy Spit shelter the site from heavy waves originating from the North or Northwest, the gap between them allows a segment of each wave through to impact the site. Once through the gap, the complex bottom topography refracts the waves creating High, Low and Very Low energy zones on the Northend Landfill.



Map showing location of project at north tip of Indian Island, at mouth of Kilisut Harbor.

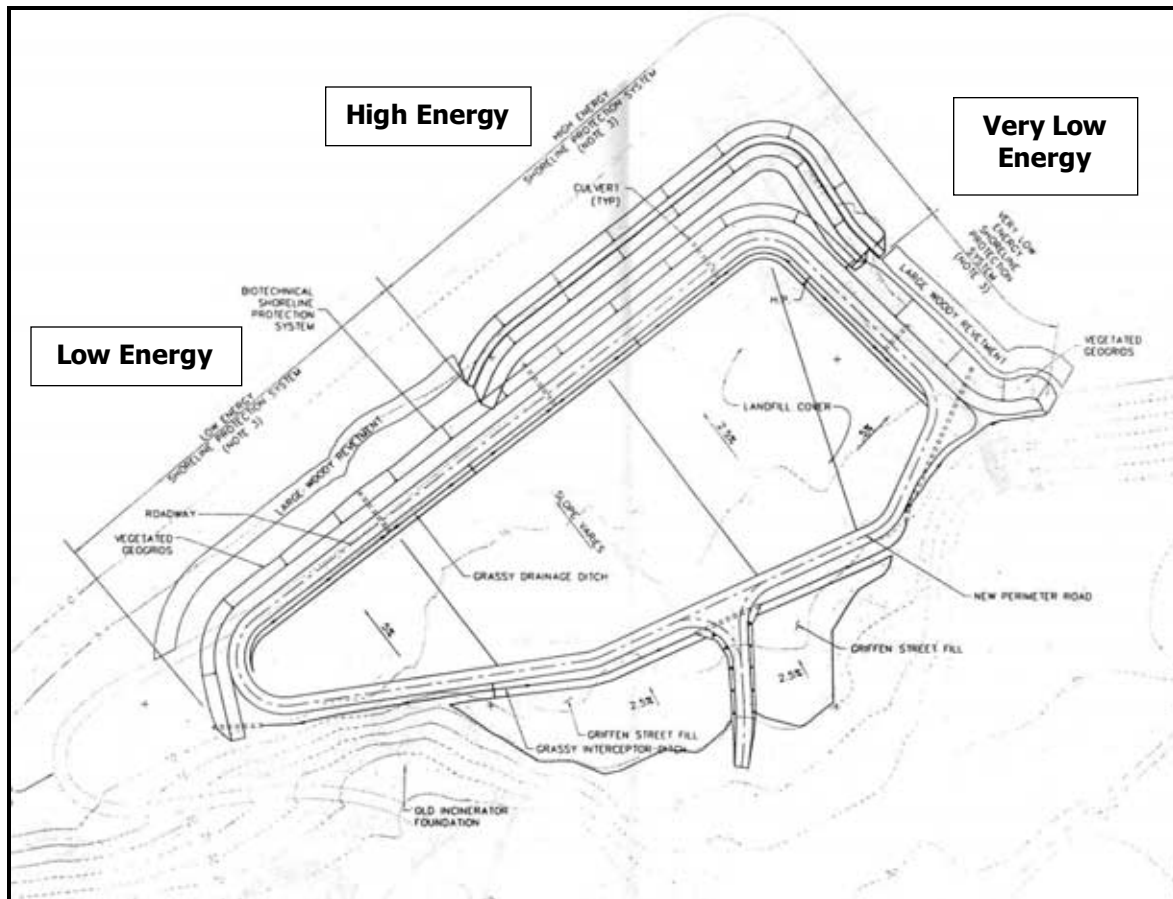
Project Description

The erosion protection at the North End Landfill is a combination of rip rap, large woody debris placement, and bioengineering. The exact design varies with the level of wave energy in each segment of the site.

High Energy: This segment begins with an excavated rock toe over-laid with a rock revetment.

Following the rock is a cobble bench that merges into a 2H:1V vegetated geogrid. The geogrid is a series

of geogrid lifts laid on top of one another to create a stepped berm. The lifts are geotextile wraps (coir and Tensar® geogrid) filled with compacted sediment. Both the geogrid and the top of the bank were planted with appropriate species. (see profiles)



Site plan, showing areas of different wave exposure.

Low Energy: In this section of beach large woody debris was substituted for rock. This follows the concept of softer protection for lower energy sites. The woody debris is secured to the beach with derivable anchors (no excavation necessary).

Very Low Energy: The final section, adjacent to the tidal lagoon, is very similar to the low energy solution. It differs in that it uses a larger quarry spall toe and has reduced quantities of woody debris.

Monitoring

The profile of the beach is being monitored to determine where accretion and erosion are occurring along the site. This began in October of 1997, is being performed along eleven transects and occurs in the spring, the fall and potentially after severe storm events.

Success

The project has been successful to date.

Alternatives Considered

The original proposal for this project was a modified riprap revetment. The denial of this proposal by the WDFW prompted the Navy and consultants to redesign the project, using both rock and bioengineering elements.

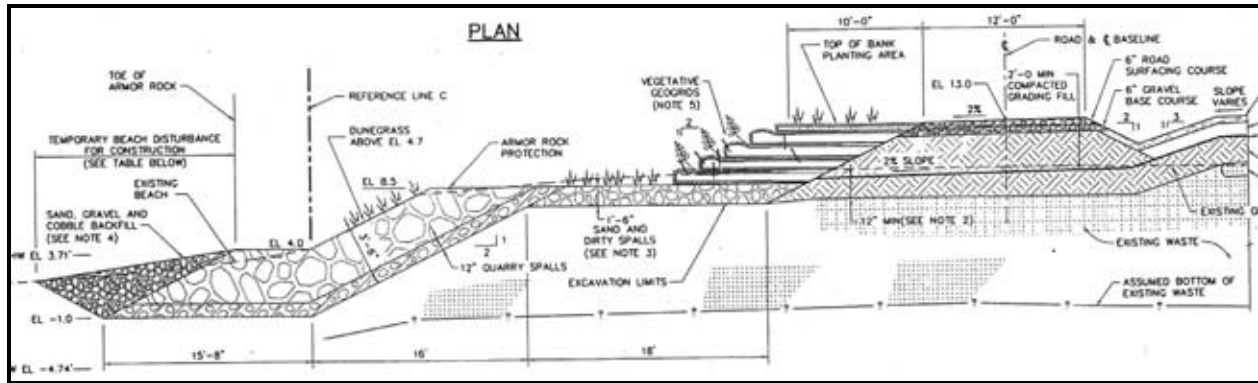
Contacts

Department of Fish and Wildlife:	J. Boettner (now with WA State DNR)
Department of Ecology:	M. Abbett
United States Navy:	B. Kalina
Agua Tierra Environmental Consulting, Inc.:	C. Fromuth

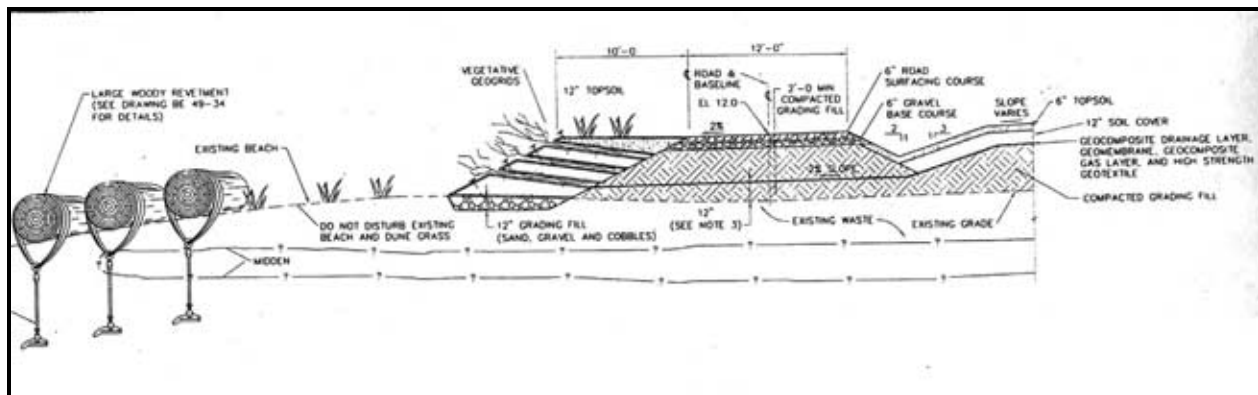
References

Ebasco Environmental. 1995. Site Work Plan – Construction of Landfill Cap and Shoreline Protection System, Site 10 Northend Landfill, Naval Ordinance Center Pacific Division Detachment Port Hadlock, WA. Contract No. N44255-93-D-4050.

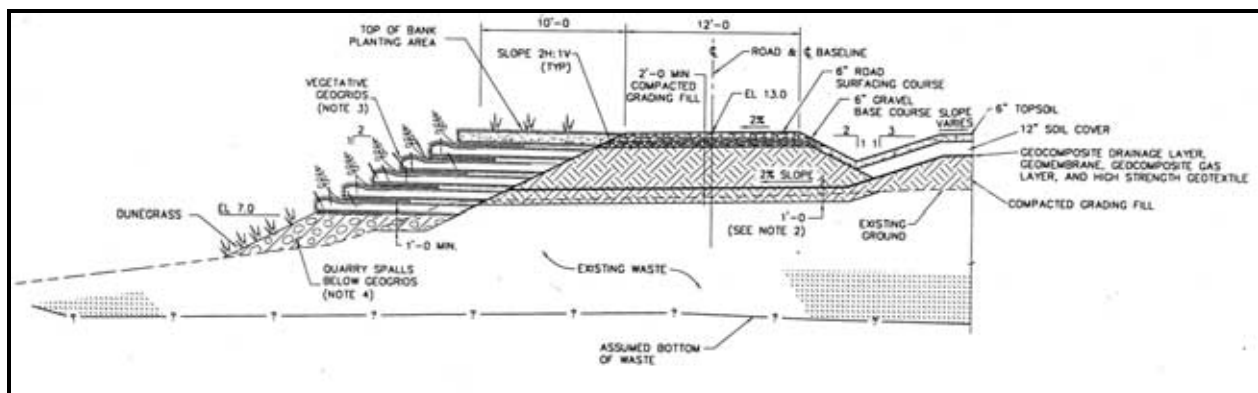
Project Design Profiles: High Low and Very Low Energy Zones



High energy zone



Low Energy Zone



Very Low Energy Zone

Alternative Bank Protection Methods on Puget Sound



Photo 1. Low energy zone. Coarse woody debris anchored to the beach, with vegetation planted on berm between upper logs.



Photo 2. View southwest from northern end of project. A rock revetment is used in the high energy zone.



Photo 3. Erosional scarp in bank prior to construction, exposing waste from former landfill (*Photo: courtesy of Bill Kalina, Navy*).



Photo 4. Geogrid lifts are obvious immediately following construction. Geotextile fabric completely covers lifts, but was quickly obscured by vegetation (*Photo: courtesy of Bill Kalina, Navy*).



Figure 5. Natural fiber geotextile. Coir fabric is exposed on the face of a geogrid lift.



Figure 6. Tensar type geotextile. Plastic grid is used for long-term structural support.

Odermat Residence

Address: **Manzanita Rd.**

Region: **Agate Pass, NW Bainbridge Is.**

Designer: **Shannon & Wilson**

Contractor: **Waterfront Construction**

Owner: **M. Odermat**

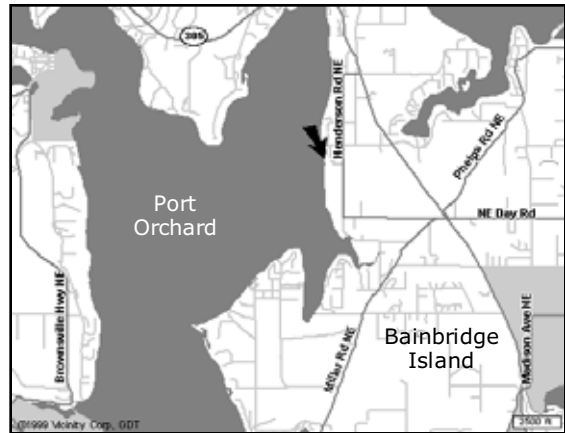
Shoreline Type: **Beach backed by high bluff**

Wave Energy: **Low**

Tides: **MHHW: +11.40**
Extreme High: +15.5
Extreme Low: -4.5

Cost: **N/A**

Date Completed: **1998**



Location: Odermat Residence on Bainbridge Island

Site History / Description

The Odermat residence is located along 375 feet of shoreline on the northwest shore of Bainbridge Island. The house is situated well back from a steep 40-foot bluff. The toe of the bluff along the northern two thirds of the site is buried by the colluvium from previous slides. The southern third of the shoreline had been previously armored with a rock bulkhead and sacrete (concrete-filled sandbags) wall.

The original path to the beach was cut between 30 and 40 years ago. The excavated material was placed on the beach in front of the bluff as fill and protected with the sacrete bulkhead. Part of this bulkhead (below where the new dock now stands) jutted out onto the beach forming a small promontory.

The property has poor drainage and the bluff contained abundant seeps. The shoreline along the bluff is a documented surf smelt spawning beach.

Project Description

The Odermat project consisted of several phases: removal of the promontory; toe protection along the waterward edge of the colluvium; placement of imbedded rocks in the beach and beach nourishment; and construction of a rock bulkhead to support the sacrete wall and the portion of the bank where the promontory was cut back.

Prior to this project, the colluvium in front of the bluff was subject to erosion by wave action at the highest tides and had undercut in two areas. The north section of this project was designed to address this

problem. The undercut areas were packed with 8-inch minus quarry spalls and a 45 degree revetment of spalls was placed along the colluvium toe the entire length of the northern section. Quarry rock, approximately 24 inches in diameter, was excavated into the beach approximately 20 feet waterward of the colluvium such that no more than 8 inches of rock was exposed above beach grade. A 1-foot zone of 3-inch minus gravel was placed landward of the buried rock to provide drainage and help prevent winnowing of finer sediments between the larger rock voids. The spall revetment and area between the buried rock and colluvium were then capped with 3/8ths inch pea gravel to both nourish the beach and provide spawning substrate for surf smelt. Overall, the procedure changed the upper beach grade from approximately 11 percent to approximately 5 percent, creating a "berm" waterward of the colluvium.

The Department of Fish and Wildlife required the removal of the promontory and beach nourishment to compensate as partial mitigation for the negative impacts of shoreline armoring and other construction impacts (i.e. pier installation). Initially, the new rock bulkhead was to be placed in front of the old sacrete wall and colluvium. Following removal of the promontory (bulkhead and fill), a new rock bulkhead was constructed against the newly established bankline and sacrete wall. During construction, the sacrete wall collapsed and it was discovered that a large void existed landward of the wall; probably a result of upland drainage and wave induced erosion. The wall was removed and the rock bulkhead was constructed further back than originally thought possible. Three-foot base rock was keyed into the beach and the upper courses of 2-foot diameter rock were keyed into the bank to create an approximately 6-foot high wall.

Monitoring

No formal monitoring exists for this project. However, the site has been visually inspected and photographed on several occasions. The project has passed through two winters and is in good condition. After the first winter, there appears to be accretion landward of the buried rocks, with some materials moving from south to north along the shoreline and onto the adjacent property. Seasonal erosion of finer sediments along the face of the buried rocks has also been noted, resulting in greater exposure of the rocks.

Success

The project has so far limited erosion of the colluvium and resulted in a relatively stable beach. Surf smelt eggs were discovered at the site several months after its installation.

Alternatives Considered

The original project design called for a rock bulkhead along the entire length of the shoreline.

Washington Department of Fish and Wildlife required mitigation and recommended use of an alternative approach. The final plan was a negotiated compromise between the consulting engineer, landowner, and WDFW Habitat Biologist.

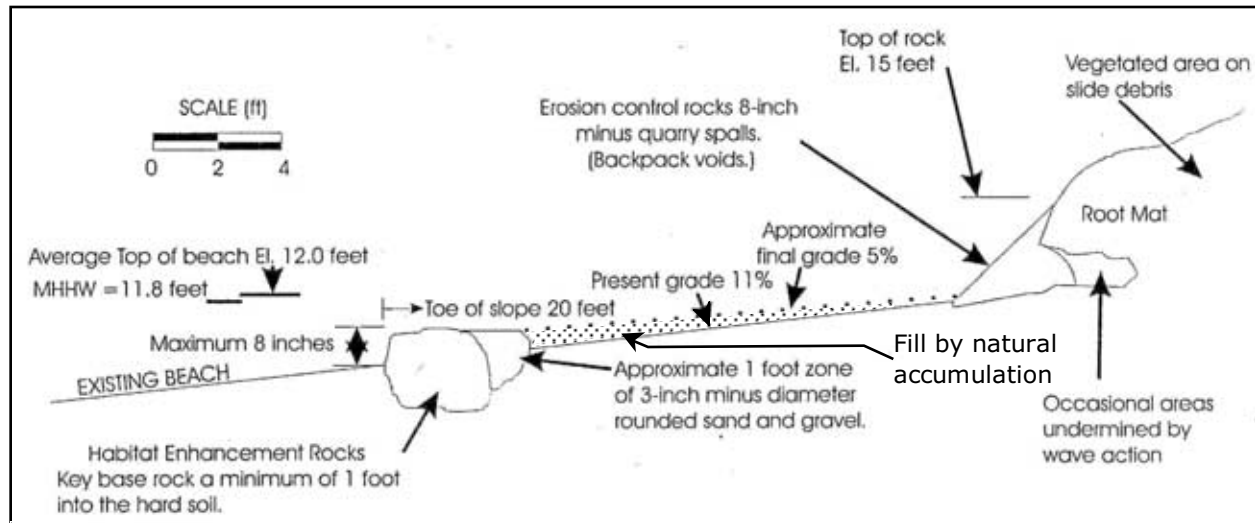
Contacts

Washington State Dept. of Fish & Wildlife	J. Brennan (now with King County DNR)
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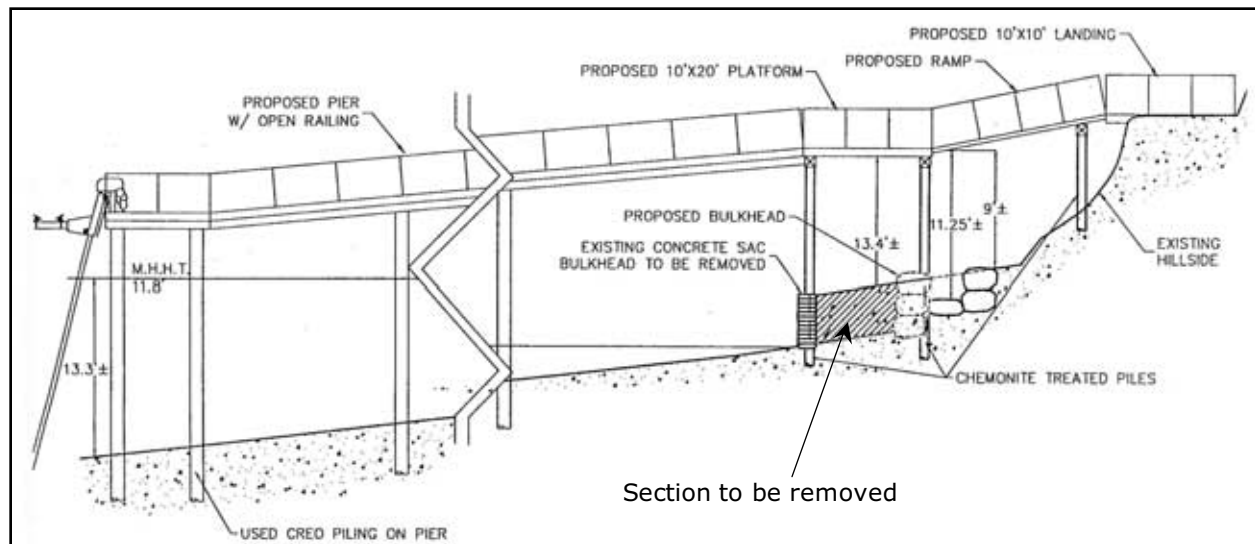
Shannon & Wilson	B. Dorwart
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Bainbridge Island Planning Department.	K. James, K. Morrisson
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Project Design Profiles



Profile: West end of the site – toe protection and habitat enhancement rocks



Profile: Central section – removal of existing bulkhead and fill as mitigation



Figure 1. View of Odermat site showing bluff, base of pier, and row of rocks buried in the beach.



Figure 2. Rock bulkhead constructed on shore south of pier.



Figure 3. This row of boulders was placed to help stabilize upper portion of gravel beach.